

APPENDIX A4-B

QUALITY-CONTROL SAMPLES COLLECTED BY FIELD PERSONNEL FOR WATER-QUALITY STUDIES

Prepared by F.D. Wilde, U.S. Geological Survey,
Reston, Va.; T.L. Schertz, U.S. Geological Survey,
Lakewood, Colo.; and S.W. McKenzie,
U.S. Geological Survey, Portland, Oreg.

Appendix A4-B—Quality-control samples collected by field personnel for water-quality studies

[Common types of QC samples are described in this table; the list is not comprehensive. Some terms, descriptions, and purposes for quality-control samples have been compiled and modified from Sandstrom (1990), Horowitz and others (1994), Shelton (1994), Koterba and others (1995), unpublished course notes from "Quality-Control Sample Design and Interpretation," and the following Branch of Quality Systems Technical Memorandums: 90.03, 92.01, 95.01; QC, quality control; Blank-water abbreviations ¹: PBW, pesticide-grade blank water; VBW, volatile-grade blank water, IBW, inorganic-grade blank water]

BLANKS² Quality-control samples used to assess possible source(s) and (or) magnitude of sample contamination		
Sample type	General description³	Purpose³
Ambient blank	<p>Blank water that is exposed to the identical collection and processing areas and time period as environmental samples. The blank water is transferred from the stock-solution container to the same type of bottle used for an environmental sample. The specific mode of exposure to the atmosphere is determined by the QC objective.</p> <p>Examples:</p> <p>(a) The blank water is transferred to a sample bottle while in the sample-processing chamber used for environmental samples.</p> <p>(b) Container such as a sample bottle is prefilled with blank water, opened while in the processing chamber, and exposed to the chamber atmosphere throughout the processing of environmental samples.</p>	<p>Determine analyte concentrations present in the environmental sample that could be attributed to exposure of sample to the ambient atmosphere in which samples are collected, processed, and analyzed.</p> <p>Referring to the general description: Example (a) is used to assess concentrations after processing the blank in a manner that mimics collection of the environmental sample. Example (b) is used to indicate the maximum analyte concentration that would result from prolonged sample exposure to ambient conditions.</p>
Source-solution blank	Stock solution of PBW, VBW, or IBW that is transferred to a sample bottle in an area of the office laboratory within a controlled atmosphere that is relatively clean and protected with respect to target analytes.	Determine the source of water used for blanks and the degree to which the composition of blank solution could have changed (with respect to target analytes) from time of laboratory certification to time of use.
Trip blank	A sample bottle filled at the laboratory with VBW, PBW, or IBW (usually VBW) that remains unopened and is carried to the field and is stored and shipped with the environmental samples.	Determine whether shipping, storage, and field transport can be a source of sample contamination or cross-contamination.

Appendix A4-B—Quality-control samples collected by field personnel for water-quality studies—Continued

BLANKS ² —Continued		
Quality-control samples used to assess possible source(s) and (or) magnitude of sample contamination		
Sample type	General description ³	Purpose ³
Equipment blank In this example, the sample referred to as the equipment blank is the same as the filter blank, as the filter assembly is the last component of this sampling-equipment system.	<p>Blank water that is passed sequentially through each component of the equipment system to be used for collecting and processing environmental samples and resulting in a single final blank sample.</p> <ul style="list-style-type: none">• Differs from a field blank in that the equipment blank is processed under controlled conditions in an office laboratory and before equipment will be used for field work. Collected annually, unless equipment is in constant use and regularly quality controlled.• Often results in collecting a series of blank samples sequentially, each sample of which represents a different component or combined components of the equipment system used. The blanks generated in such a series are a special case of the generic term that identified the QC sample type. For example, if processing a water sample through a DH-77 sampler, churn splitter, peristaltic pump, and filter assembly, in that order, the following set of samples could be collected to be associated with the equipment blank:<ul style="list-style-type: none">- Sampler blank (blank water processed through the DH-77 sampler).- Splitter blank (blank water processed through the sampler and then through a churn splitter).- Pump blank (blank water processed through the sampler, churn splitter, and then through a peristaltic pump system).- Filter blank (blank water processed through the sampler, churn splitter, peristaltic pump system, and through the filter assembly).	<ul style="list-style-type: none">• Identify effects of the equipment system used to collect and process samples on analyte concentrations.• Verify adequacy of equipment-cleaning procedures (NFM 3).• Relating to components of the equipment system, assess potential of sample contamination and adequacy of equipment-cleaning procedures associated with each component of the equipment system to be used for field work.

Appendix A4-B—Quality-control samples collected by field personnel for water-quality studies—Continued

BLANKS²—Continued		
Quality-control samples used to assess possible source(s) and (or) magnitude of sample contamination		
Sample type	General description³	Purpose³
Field-blank system ("The field blank"—see fig. 4-8)	Blank water that is passed through the entire sampling equipment system onsite and subjected to identical collection, processing, preservation, transportation, and storage procedures and laboratory handling as for environmental samples. An identical sequence of procedures is followed as for the equipment blank. <ul style="list-style-type: none"> The field blank is processed onsite through clean equipment on the same day as environmental samples: <ul style="list-style-type: none"> (a) directly after the equipment has been field cleaned and before leaving for the next site (NFM 3) or (b) at the next site, just before environmental samples for that site are processed. A set of blanks can be processed and associated with the field blank, analogous to the equipment blank. 	Determine the concentrations of target analyte(s) that could be present in environmental sample attributable to field procedures for equipment cleaning and sample handling. Results include effects from laboratory handling. <p>Examples related to (a) and (b) under General description: (a) Check the adequacy of field cleaning procedures (demonstrate that equipment was adequately decontaminated after previous use) (NFM 3); (b) Identify contamination of sampling equipment while in transport from office to field site or between field sites, and ambient field conditions at the field site.</p>
Sampler blank	Blank water processed through the same sampler used for environmental samples. (Blanks processed through pump samplers usually are designated pump blanks.)	<ul style="list-style-type: none"> Identify effects of sampler on analyte concentrations. Verify adequacy of cleaning procedures (NFM 3).
Splitter blank	Blank water processed through the same sample-splitting device used to collect or to process environmental samples (such as a churn splitter, cone splitter, or manifold system).	<ul style="list-style-type: none"> Identify effects of splitter on analyte concentrations. Verify adequacy of cleaning procedures (NFM 3).
Pump blank	Blank water processed through the pump-and-tubing system used for environmental samples.	<ul style="list-style-type: none"> Identify effects of pump on analyte concentrations. Verify adequacy of cleaning procedures (NFM 3).
Filter blank	Blank water processed through the filter assembly used for environmental samples. If the filter blank is to represent the same filter media, blank is processed prior to environmental samples.	<ul style="list-style-type: none"> Identify effects of filtration assembly on analyte concentrations. Verify adequacy of cleaning procedures, if a plate or cartridge assembly is used—see NFM 3.

Appendix A4-B—Quality-control samples collected by field personnel for water-quality studies—*Continued*

BLANKS²—Continued		
Quality-control samples used to assess possible source(s) and (or) magnitude of sample contamination		
Sample type	General description³	Purpose³
Preservation blank	Blank water that is transferred to a sample bottle and chemically treated with a preservative in an area protected from atmospheric contamination (usually, the office laboratory). The preservative used is from the same lot number used for other QC and environmental samples.	Determine the potential for and magnitude of sample contamination from the chemical treatment to be used to preserve the environmental sample.
Shelf blank ("Hold" blank)	Blank water that is transferred into the same type of bottle used for an environmental sample (usually in the protected environment of the office laboratory) and stored adjacent to stored environmental samples for the same length of time.	Determine the potential for and magnitude of sample contamination from sample storage in a designated area for a designated length of time.
Refrigerator blank	Blank water that is transferred into a sample bottle (usually in the protected environment of the office laboratory) and stored adjacent to environmental samples in a refrigerated area for the same length of time.	Determine the potential for and magnitude of sample contamination from sample refrigeration for a designated length of time.

Appendix A4-B—Quality-control samples collected by field personnel for water-quality studies—*Continued*

REPLICATE AND VARIABILITY SAMPLES Quality-Control Samples Used To Assess Field and Laboratory Variability		
Sample type	General description³	Purpose³
Replicates (duplicates, triplicates, etc., of sequential, split, concurrent, or other type of replicate)	A set of samples that are collected close in time and space and in a manner so that the samples are thought to be representative of the ambient water composition at the time of collection.	Depending upon its type, a replicate is used to determine variability in some part of the sample collection, processing, and analysis system.
Concurrent replicates	Samples obtained by collecting simultaneously with two or more samplers or by using one sampler and alternating collection of samples into two or more compositing containers (Horowitz and others, 1994).	<ul style="list-style-type: none"> • Identify and (or) quantify the variability in the system being sampled. • Analysis includes the variability introduced from collection, processing, shipping, and laboratory handling and analysis of the sample.
Sequential replicates	Samples that are collected one after the other and considered virtually identical in composition.	<ul style="list-style-type: none"> • Identify and (or) quantify the variability introduced from collection, processing, shipping, and laboratory handling and analysis. • Can be designed to indicate temporal variability resulting from consecutive collection of samples.

Appendix A4-B—Quality-control samples collected by field personnel for water-quality studies—Continued

REPLICATE AND VARIABILITY SAMPLES —Continued		
Quality-Control Samples Used To Assess Field and Laboratory Variability		
Sample type	General description ³	Purpose ³
Split replicates	Samples obtained by dividing one sample into two or more subsamples either before or after sample processing and preservations each of the subsamples is to be analyzed for concentrations of the same constituents or compounds. Examples: (a) A processed and treated sample in a sample bottle is split into two or more aliquots and subjected to identical handling and analysis. (b) Environmental water is passed through a splitting device (such as a cone splitter or T-valve) from which subsamples are collected simultaneously and subjected to identical handling and analysis. (c) Environmental water is collected into a compositing device from which subsamples are collected sequentially and subjected to identical handling and analysis.	<ul style="list-style-type: none">• Assess variability for a given sample matrix.• Compare differences in analyses obtained from the same or separate laboratories.• Analysis includes any variability from splitting and other sample-processing procedures, shipping, and laboratory handling and analysis of the sample.
Reference sample	A laboratory-prepared solution or material whose composition is certified for one or more properties so that it can be used to assess a measurement method or for assigning concentration values of specific analytes.	Tests for bias and variability of the laboratory measurement process.
Spike sample	Environmental ("field-matrix spikes") or reference-material sample to which a spike solution has been added in known concentrations and in a manner that does not substantially change the original sample matrix. Spike solution is a solution having laboratory-certified concentrations of selected analytes and that is added in known quantities to a sample. ⁴	Assess the recovery of target analytes relative to the actual conditions to which samples have been exposed; quantify effects of sample-matrix interferences and analyte degradation on analyte recovery.

Appendix A4-B—Quality-control samples collected by field personnel for water-quality studies—*Continued*

REPLICATE AND VARIABILITY SAMPLES —Continued Quality-Control Samples Used To Assess Field and Laboratory Variability		
Sample type	General description³	Purpose³
Blind sample	A sample (typically, reference material) submitted for laboratory analysis with composition known to the submitter but unknown (blind) to the analyst. Every blind sample analyzed should have an associated reference to the source and the preparation procedure.	Test for bias and variability of the laboratory measurement process.

¹Blank water is a solution that is free of analyte(s) of interest at a specified detection limit and that is used to develop specific types of QC samples. USGS personnel are required to use blank water that has been analyzed and certified to be of a specific grade. Order IBW from the QWSU in Ocala, Fla., via <Ocalaman@usgs.gov>. Order PBW and VBW from NWQL in Arvada, Colo. via <densuppl@usgs.gov>.

²Blanks for trace-element analysis have a unique NWQL schedule of analysis, different from that of the environmental sample.

³The description of a QC sample depends to some extent on the purpose for which it is collected. The purpose for the QC sample can govern the mode of its collection, processing, and treatment, and the equipment to which it is exposed. Purposes for a specific type of QC sample are varied.

⁴Obtain spike solutions in spike kits for pesticide and volatile organic compound analyses supplied by NWQL.